

## **ABSTRACT**

The present invention generally relates to an apparatus and method for obtaining absolute values of concentrations of chromophores of a medium and/or absolute values of their ratios. More particularly, the present invention relates to non-invasive optical systems and methods for determining absolute values of oxygenated and/or deoxygenated hemoglobins and their ratios in a physiological medium. The optical system typically includes (1) a body, (2) a source module supported by the body, optically coupling with the medium, and irradiating into the medium multiple sets of electromagnetic waves with different wave characteristics, (3) a detector module supported by the body, optically coupling with the medium, and detecting such electromagnetic waves, and (4) a processing module operatively coupling with the detector module, and determining the absolute values of the concentrations and the ratios thereof from multiple wave equations applied to the source and detector modules. The processing module is designed to obtain such absolute values by a method typically including the steps of (1) obtaining multiple sets of wave equations, (2) eliminating source-dependent and detector-dependent parameters therefrom to obtain a set of intermediate equations, (3) providing a correlation of medium-dependent and geometry-dependent parameters with the chromophore concentrations or ratios thereof, (4) incorporating the correlation into the set of intermediate equations, and (5) obtaining the absolute values of the chromophore concentrations and ratios thereof.

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